Safe recovery, neutralization, and destruction of bulk explosives

Presented at:
2023 SAFEX Congress

Presented by:
Professor Valentine Nzengung
CEO/CTO, MuniRem Environmental, LLC

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Presentation Outline

- Introduction to MuniRem Technology and Company
- Primary Explosives
- Secondary Explosives
- Dynamite (Sweating Dynamite)
- Summary and Conclusion

INTRODUCTION TO THE MUNIREM SOLUTION

What is the MuniRem Technology?

- A University of Georgia patented innovation commercialized under the Trademark MuniRem®
- Achieves near-instant neutralization and destruction of explosives and chemical warfare agents in an aqueous solution
- Invention based on reduction chemistry mediated by sulfur oxides and other enhancers
- Stabilizes metals as insoluble metal sulfides, thus used for heavy metals remediation
- End-product from reactions is non-hazardous waste
- Versatile and Scalable
- Exclusively licensed to MuniRem Environmental, LLC founded by the inventor at Univ. of Georgia

What can the MuniRem reagent do?

Versatility of Chemical Reagent

Military Explosives
- C4
- HMX
- PETN
- RDX
- Semtex

Commercial Explosives
- ANAL
- ANFO
- Black Powder
- Dynamite
- Nitroglycerin
- Smokeless Powder
- TNT
- Urea Nitrate

Improvised Explosives*
– HMTD
– TATP

Other Contaminants
– Heavy Metals
– Reactive Aluminum
– Halogenated Organics

Proven Processes/Applications

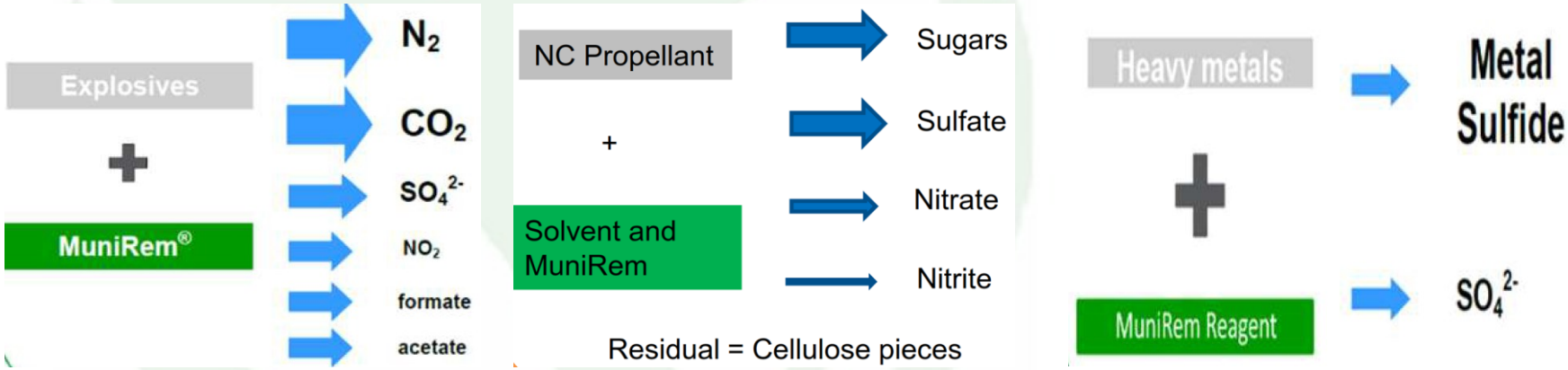
Demilitarization:
- Bulk explosives neutralization
- Demilitarization derived waste
- Recovered underwater munitions
- Humanitarian demining
- Neutralization of Fireworks/Flares

Decontamination:
- Explosives manufacturing equipment
- Former explosive manufacturing buildings
- Scrap metal & bomb casings
- Indoor Training Range Maintenance

Remediation:
- Rapid soil remediation
- Groundwater remediation
- OB/OD site remediation

Unique Properties of the Chemical Reduction Reagent

End Products after chemical neutralization and destruction are **non-hazardous**



MuniRem Reagents and Packaging

Types

- MuniRem-R541E
- MuniRem-R532E (PETN)
- MuniRem-R811E (PETN)
- MuniRem-FE (Booster)
- MuniRem-Foam
- MuniRem-BC

- All varieties available in deodorized versions (MuniRem-RxxxE-D) which mask the sulfur odor.
- Deodorized MuniRem products are provided upon Client's request.

Packaging

- 5lb Pail, sold in packs of 4 (limited availability at present)
- 45lb Pails (normally available ex-stock)
- 200lb Drum (available to order)
- Portable Field Kit with 4 x 2lb (1kg) jars of different MuniRem Reagents

5lb (2.2kg) pail

45lb (20.5kg) pail

220lb (100kg) Drum

Portable Field Kit

Packaging and Shipping

1.

5lb pails shipped in overpack of 4 pails

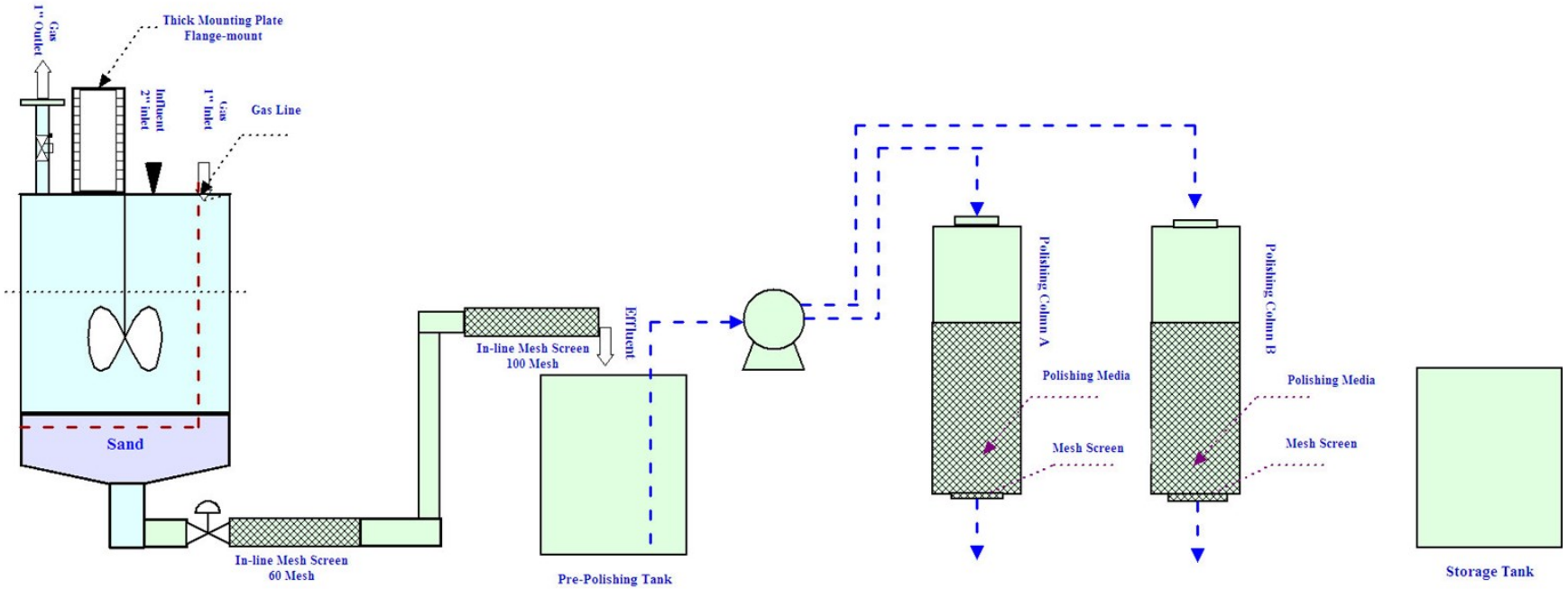
45lb pails shipped on standard pallets up to 18 pails per pallet

220lb drum shipped as is or on pallet.

Demonstration & Validation Tests

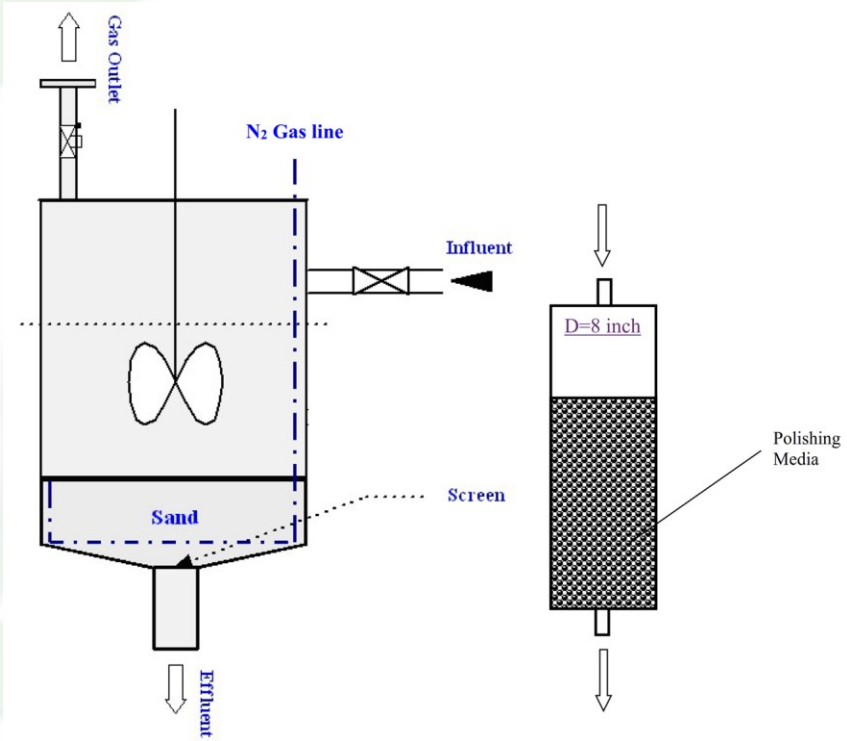
From Bench Scale to Full Scale

Pilot Scale Reactor - Chemical Neutralization of Recovered Bulk Explosives (schematic)



Custom Built Neutralization Reactor for Bulk Energetics

- Waterjet breaching of Navy Projectiles
- 100 gallons neutralization tank
- 10 Lbs explosive per batch
- Manual loading of explosives
- Reaction time < 1 hour
- Polishing column – packed bed reactive media

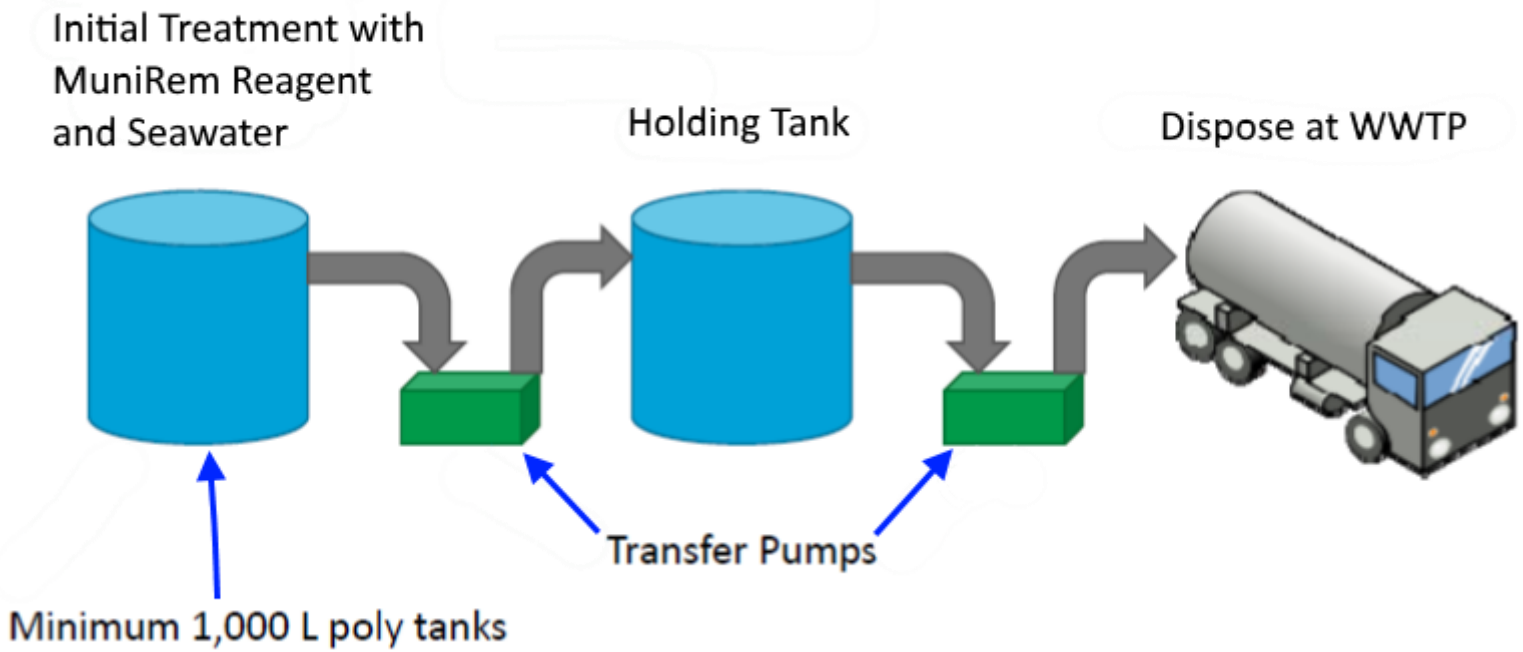


Pilot Scale Demonstration
Neutralization of Multiple 10 lb Batches of Bulk Explosives

- Neutralization in under 30 minutes
- Effluent wastewater target of 2 ppm explosives
- Decontaminated casings to MDAS
- Non-hazardous wastewater
- Water recycling and re-use

Custom Built Explosive Neutralization Reactor

Scale-up Option
Versatile Small-Scale Demilitarization



Chemical Neutralization and Destruction of Primary Explosives

Stored under unsuitable conditions

Neutralization of Bulk Dextrinated Lead Azide (DLA)





Bulk kill of DLA via MuniRem: Approximately 1.5 lbs of wetted DLA was placed in a conductive tray. Hot water was added. 3+ lbs of MuniRem-R811E was added. A gentle no-contact stir followed. Within 2 hours, all was black.

Verification of Lead Azide Neutralization and Destruction by MuniRem Reagent

Blackened PbS remains of DLA bulk kill with MuniRem reagent.
No DLA activity was evident in the open flame test

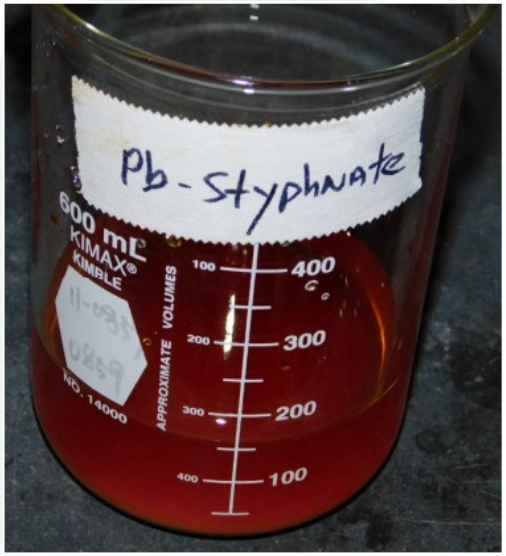
Decontamination of Lead Azide Contaminated Accessories

Bucket with MuniRem solution and diapers, tags, strings, rags, etc.

No DLA activity on the treated materials

Neutralization and Destruction of Lead Styphnate

Lead Styphnate



After the addition of MuniRem-R811E and Water

Lead Styphnate post MuniRem Treatment – Zero activity in an open flame

Disposal of Poorly Stored High Explosives in a Magazine after more than a Decade

Lead Styphnate

Tetracene

Magazine Interior with poorly stored primary explosives

Disposal of Poorly Stored High Explosives in a Magazine after more than a Decade

Magazine After Neutralization and Disposal of Explosives

Spray Application of Chemical Neutralent to Render Safe Entrance into Explosives Storage Magazine

Chemical Neutralization and Destruction of Secondary Explosives

The focus is on explosive sludge and abandoned military explosives

Chemical Neutralization and Destruction of Explosives in Wastewater Sludge

Accumulation of Explosives Wastewater and Sludge at Iowa AAP

Contractor Effort to Neutralize and Destroy Explosives in Sludge Prior to Arrival of MuniRem Staff

Rapid Neutralization of Explosives Sludge from Wastewater Tank with MuniRem Reagent

Safe Recovery and Neutralization of Bulk Explosives (H-6) on Equipment

- Melter/Flaker machine contained bulk H-6 (TNT, RDX, AL, Binder) explosives
- Large crystallized chunks of H-6 on equipment
- Wall surfaces and miscellaneous materials contaminated with explosives
- Lead paint chips mixed in with explosives

Small Footprint of MuniRem Solution Application

Explosives Neutralization Station Behind Building

MuniRem Solution Provided Safe Recovery of Crystallized Explosives

- Large H-6 chunks were safely removed while spraying MuniRem solution
- Large explosive pieces transferred to neutralization reactor
- Neutralization of recovered explosives achieved rapidly in reaction tanks

Neutralization of Recovered Explosives

- 2,000 Lbs of H-6 explosives estimated as present on and in equipment
- >1000 lbs destroyed in place by spraying concentrated MuniRem solution
- >900 lbs recovered and neutralized on-site in reactor with MuniRem solution
- Sludge and wastewater characterized as non-hazardous waste

Chemical Neutralization and Destruction of Dynamite in Abandoned Magazines

Hazard is highly unstable nitroglycerine sweating out of the dynamite sticks

Chemical Neutralization and Destruction of Dynamite Abandoned in Storage Magazine

Storage Magazine Before Doors Opened

Contents of Explosive Storage Magazine

Over Half Ton of >40 Years Old Dynamite

Sweating Dynamite in Magazine Soaked with MuniRem Reagent Solution

Chemical Neutralization and Destruction of Dynamite Abandoned in Storage Magazine

Dynamite Soaked with MuniRem Solution to Allow for Safe Recovery

Recovered Dynamite in Plastic Tub and Soaked in MuniRem Solution

Chemical Neutralization and Destruction of Dynamite Abandoned in Storage Magazine

Destruction of Dynamite in MuniRem Reagent Solution

Packaging Left from Destruction of Dynamite

Chemical Neutralization and Destruction of Bulk Explosives Using MuniRem Reagents

Magazine Before Recovery and Destruction of Dynamite with MuniRem Reagents

Empty Magazine After Dynamite and Detonator Cord Recovery and Disposal

Another Abandoned Dynamite Magazine

Before – wood on interior walls collapsed and covering 1,300 pounds of sweating dynamite

Explosive Free Magazine

Wastewater 825 gallons

Solid Waste

Increasing Capacity by Building Government and Industry Partnerships Worldwide

Country	Private Industry	Government
Australia	X	X
Canada	X	X
Greece	X	0
Israel	X	X
Lebanon	X	X
Mexico	X	0
Netherlands	X	X
Poland	0	X
Saudi Arabia	0	X
South Africa	X	0
South Korea	X	0
United Kingdom	0	X
United States	X	X

Conclusions

We have a safe solution to destroy dynamite and other explosives without polluting our air, soil and water.

We have a solution to mitigate the world's explosives remnants of wars faster and safely.

This invention is also beneficial for combating weapons of mass destruction and humanitarian demining.

An underwater munition dump site. According to the USDoD, there are at least 32,000 tons of chemical weapons dumped in U.S. coastal waters. (Photo: Courtesy of the International Dialogue on Underwater Munitions)

Thank you.

FEEL FREE TO CONTACT ME DIRECTLY FOR ANY FURTHER INFORMATION YOU NEED.

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